

REMARKS

Applicant provides the present Preliminary Amendment to address issues raised in the Official Action mailed July 3, 2003 and the Advisory Action mailed September 17, 2003 in the parent application. Applicant has amended the title to be consistent with the elected invention. Applicant has cancelled Claims 2-10, which have been allowed in the parent application. Applicant has also amended certain claims to correct typographic errors. Applicant has cancelled the non-elected Claims 23-54 in the parent application without prejudice or disclaimer. Finally, Applicant has provided new claims 55 and 56 which Applicant submits are patentable over the cited references.

The Obviousness Rejections

In the parent application, Claims 1 and 16-20 were rejected under 35 U.S.C. § 103(a) as obvious in light of United States Patent No. 6,056,820 to Balakrishna *et al.* (hereinafter "Balakrishna") and United States Patent No. 5,853,478 to Yonehara *et al.* (hereinafter "Yonehara"). Claims 1 and 16-22 were rejected under 35 U.S.C. § 103(a) as obvious in light of Balakrishna and EP 0 962 963 to Uchida *et al.* (hereinafter "Uchida"). Official Action, p. 4. Claims 1 and 11-15 were rejected under 35 U.S.C. § 103(a) as obvious in light of United States Patent No. 5,753,038 to Vichr *et al.* (hereinafter "Vichr") and Balakrishna. Official Action, p. 4. Finally, Claims 1 and 11 were rejected under 35 U.S.C. § 103(a) as obvious in light of United States Patent No. 6,063,185 to Hunter (hereinafter "Hunter") and Balakrishna. Official Action, p. 6. Applicant will address each of these rejections individually below.

Claims 1 and 16-20 are Patentable Over Yonehara and Balakrishna

Claims 1 and 16-20 stand rejected as obvious in light of Balakrishna and Yonehara. However, Yonehara does not relate to SiC. Applicant submits that one of skill in the art would not be motivated to combine Yonehara with Balakrishna because Yonehara does not relate to SiC. The Advisory Action asserts that Yonehara relates to "general single crystal growth" based on Claim 1 of Yonehara. Advisory Action, p. 2. However, such an assertion cannot provide a proper basis for an obviousness

rejection. The prior art must suggest some reason for combining the references. The Advisory Action appears to be taking the position that because Yonehara does expressly exclude SiC that it suggests the use of the techniques of Yonehara for growing SiC. Applicants submit that such a basis for combination is improper.

Additionally, Yonehara provides a list of thin films according to the selective formation method of Yonehara. Such a list is recited at col. 6, lines 60-64 and does not include SiC. Applicants submit that it is only through hindsight that SiC could be added to that list.

Furthermore, Yonehara does not relate to boule growth as is recited in the claims. See e.g. Yonehara, col. 6, lines 40-47 ("a thin film is formed"); and col. 8, lines 17-19 ("a single crystal of a thin film material is formed"). As such, Applicant submits that one of skill in the art would not look to the thin film techniques of Yonehara to modify the conventional PVT boule growth of Balakrishna. The Advisory Action asserts that "Yonehara teaches a method of forming a single crystal by evaporation of Si into a vacuum, which is a sublimation technique." Advisory Action, p. 2. The Advisory Action, however, provides no citation for this assertion. Yonehara does describe at col. 14, lines 32-42 the use of Molecular Beam Epitaxy as performing vapor deposition in ultra-high vacuum. However, Applicant submits that one of skill in the art would not be motivated to combine MBE with sublimation boule growth. Furthermore, this technique is described for selective growth of Si on silicon nitride regions on spots of a SiO₂ layer. Applicants submit that such a technique would be inapplicable to sublimation boule growth using a SiC seed crystal.

Furthermore, Yonehara does not disclose forcing nucleation sites of a seed crystal to a predetermined pattern. While Yonehara does describe selective deposition based on differences in nucleation density, Yonehara does not describe a "seed crystal" as used in forming a boule. In fact, the cited portions of Yonehara appears to describe selective deposition of materials is provided so that island shaped single crystal grains are formed on an insulating substrate. See Yonehara, col. 9, line 59 to col. 10, line 3. Accordingly, Applicant submits that Yonehara fails to provide the recitations of Claim 1 that are missing from Balakrishna.

The Advisory Action simply asserts that references may not be attacked individually. Aside from such an assertion being legally incorrect, it is also inapplicable in this case. Applicant is not asserting that none of the references disclose a seed crystal but that neither Balakrishna nor Yonehara disclose forcing nucleation sites of a seed crystal to a pattern. In other words, there is no reason given for why Yonehara's patterned substrate would be combined with the seed crystal of Balakrishna to result in the recitations of the present claims. Such is particularly the case where the invention of Yonehara is described as:

The present invention utilizes selective deposition based on such nucleation density difference (ΔND) and, by forming sufficiently finely so that a single nucleus may grow on the deposition surface of a different kind of material having sufficiently greater nucleation density than the material of the deposition surface, a single crystal can be grown selectively only at the site where such fine different kind of material exists.

Yonehara, col. 7, lines 47-54. Neither the Official Action nor the Advisory Action provide an explanation of why one of skill in the art would combine the teaching of Yonehara that are directed to thin film formation on a deposition surface of a different kind of material with the PVT boule growth of Balakrishna.

In light of the above discussion, Applicant submits that each of the recitations of Claim 1 are neither disclosed nor suggested by Balakrishna nor Yonehara, either individually or in combination. Furthermore, Applicant submits that Balakrishna and Yonehara may not be properly combined to result in the recitations of Claim 1. Accordingly, Applicant submits that Claim 1 and the claims that depend from Claim 1 are patentable over Balakrishna and Yonehara and, therefore, request withdrawal of the present rejection.

Claims 1 and 16-22 Are Patentable Over Uchida and Balakrishna

Claims 1 and 16-22 stand rejected as obvious in light of the combination of Uchida and Balakrishna. As discussed in the parent application, Uchida does not disclose PVT. While the Final Official Action does not appear to directly address Applicant's arguments regarding CVD and PVT, the Final Official Action now asserts that Uchida teaches methods other than CVD. Final Official Action, p. 4. The cited portion of Uchida merely describes work done in an MBE **apparatus** and states that a

"CVD apparatus or the like" may also be used. Uchida, col. 15, lines 28-31.

Applicant submits that stating that a CVD or MBE apparatus may be used does not disclose or suggest a combination with a PVT process. The Advisory Action does not even address this argument. As such, Applicant submits that Uchida would not be modified or combined with Balakrishna for each of the reasons discussed in Applicant's responses in the parent application.

As motivation for combining Balakrishna and Uchida, the Official Action states that "[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Balakrishna et al with Uchida et al's mask pattern to force nucleation sites to a predefined pattern because a crystal of silicon carbide can be easily grown in a desired region (col 19, ln 1-10)." Official Action , pp. 4-5. However, Claim 1 recites boule growth. Applicant submits that the Official Action has failed to identify why, in boule growth, one of skill in the art would want to grow SiC in a desired region. The Advisory Action, likewise, only provides a conclusory reason that Uchida is not limited to thin film growth and, therefore, it would be combined with Balakrishna. Neither the Official Action nor the Advisory Action explain why an invention that is directed at provided SiC growth in only a desired region of a substrate would be used in boule growth where such is not a concern.

Furthermore, as Applicant noted in Amendments in the parent case, Uchida utilizes a mask to provide different polytypes of SiC. For example, Example 8 of Uchida states that "[t]hereby, a 4H and 6H hexagonal silicon carbide crystal with a film thickness of approximately 3 μm is grown by a step-flow growth in, for example, 1 hour." Uchida, col. 22, lines 15-17. Such growth of different polytypes is not relevant to boule growth. Accordingly, Applicant submits that the motivation for combining Uchida and Balakrishna cited in the Official Action is the type of conclusory assertion that the Federal Circuit has found insufficient for establishing a prima facie case of obviousness. Furthermore, the assertion in the Advisory Action that Uchida's teachings about different polytypes may be ignored because they are not relied on in the rejection is improper. The teachings of a reference must be taken as a whole, not bits and pieces using hindsight.

As indicated in Applicant's Amendments in the parent case, Uchida states that Example 8 relates to the stacking silicon carbide crystal layers with a different crystal system from each other. *See* Uchida, col. 22, lines 29-31. In contrast, Balakrishna relates to PVT growth of silicon carbide boules. Balakrishna, col. 1, lines 9-12. Applicant submits that one of skill in the art would not be motivated to combine a technique for growing SiC layers with different crystal systems with the PVT growth of Balakrishna because Balakrishna is concerned with growing large, single SiC crystals. *See e.g.* Balakrishna, col. 1, lines 54-56. Applicant submits that growing crystals with different crystal systems would defeat the purpose of Balakrishna of growing a single crystal. As such, Applicant submits that the techniques for growing layers with different SiC crystal systems by CVD and/or MBE may not be properly combined with the PVT system for growing a single crystal. Accordingly, Applicant submits that Claim 1 and the claims that depend from Claim 1 are patentable over the combination of Uchida and Balakrishna.

Claims 16-22 are patentable as depending from a patentable base claim, however, certain of these claims are also separately patentable. For example, Claims 17, 18 and 20 recite specific shapes formed on the SiC seed crystal. The Official Action merely states that "[i]t would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Uchida et al and Balakrishna et al by changing the shape of the predetermined pattern to grow different shapes of silicon carbide." Official Action, p. 4. Applicant submits that the shape of the pattern does not control the shape of the silicon carbide grown. As such, the motivation asserted in the Official Action for modifying Uchida and/or Balakrishna is incorrect and irrelevant. The Official Action, however, never addressed this argument but merely makes the same erroneous statement.

Furthermore, with regard to the assertion that In re Rinehart provides a basis for rejecting Claims 17, 18 and 20, Applicant requested that the Examiner indicate where in In re Rinehart support is found for the assertion that, in the art of semiconductor fabrication, all changes in shape have to provide unexpected results. However, the Official Action points to no portion of Rinehart as requested by Applicant. Thus, Applicant submits that an unspecified "mask" of Uchida does not

disclose or suggest differing shapes as recited in Claims 17, 18 and 20. Thus, Applicant submits that Claims 17, 18 and 20 are separately patentable for at least these additional reasons.

Claims 1 and 11-15 Are Patentable Over Vichr and Balakrishna

Claims 1, and 11-15 stand rejected as obvious in light of Vichr and Balakrishna. Vichr describes growing single crystal diamonds by CVD. *See e.g.* Vichr, col. 7, lines 25-27. While Vichr states that another application relates to SiC growth, the method of Vichr is described as providing diamond growth. Vichr, col. 1, lines 18-24. Vichr does not describe growth of any crystal other than diamond. Vichr does not describe PVT growth but describes CVD growth of diamond. The portion of Vichr with the Official Action cites as stating the "the crystal growth technique used to grow the large crystals is not critical" specifically states that the diamond growth technique can be accomplished by any method and then goes on to list a number of CVD methods, plasma jet and combustion flame diamond growth. *See* Official Action, p. 6 and Vichr, col. 8, line 55 to col. 9, line 5. Furthermore, Vichr specifically states that the growth techniques are those for growing epitaxial layers, not boules. Thus, Vichr again is discussing diamond growth techniques and does not discuss PVT or the growth of boules. Thus, for analogous reasons to those discussed above with reference to Uchida, CVD references are not properly combinable with the PVT process of Balakrishna. Accordingly, Claim 1 and the claims that depend from Claim 1 are neither disclosed nor suggested by Vichr and Balakrishna, either alone or in combination.

Claims 1 and 11 Are Patentable Over Hunter and Balakrishna

Claims 1 and 11 stand rejected as obvious in light of the combination of Hunter and Balakrishna. Official Action, p. 7. In particular, Hunter is cited as teaching each of the recitations of Claim 1 except growth of a silicon carbide boule. Official Action, p. 8.

Applicant wishes to point out that Hunter does disclose growth by sublimation which is PVT and could be used for growth of boules. However, as discussed in

Applicant's previous Amendment in the parent case, Hunter does not disclose or suggest forcing nucleation sites of a seed crystal to a predefined pattern as recited in Claim 1. Hunter discloses providing a pattern of nucleation sites but the sites are not of a seed crystal but are part of a graphite cooling disc. *See* Hunter, Fig. 6A. In Hunter, nucleation sites are provided by one of two methods: providing unseeded nucleation sites on the disc member 23; and providing seeded nucleation sites within the disc member 123. *See* Hunter, col. 6, lines 6-15 and 57-59. The disc member 23 is graphite. *See* Hunter, col. 5, lines 65-67. Likewise, the disc member 123 has a seed 160 inserted into it rather than being a seed crystal itself. *See* Hunter, col. 6, line 57 to col. 7, line 7. In contrast to the discrete nucleation sites provided by Hunter, embodiments of the present invention provide for forcing nucleation sites in a seed crystal, not providing nucleation sites, seeded or otherwise, in a different material such as the graphite member of Hunter.

Balakrishna also does not disclose or suggest forcing nucleation sites in a seed crystal as recited in Claim 1. Balakrishna merely discloses the use of PVT for SiC growth. Neither Balakrishna nor Hunter, either alone or in combination, disclose or suggest forcing nucleation sites of a seed crystal as recited in Claim 1. Accordingly, Applicant submits that Claim 1 and the claims that depend from Claim 1 are patentable over Hunter and Balakrishna.


With regard to Claim 11 Applicant further submits that Claim 11 is separately patentable over the cited references. For example, Claim 11 recites "forming a pattern on an exposed surface of the seed crystal so as to provide regions of the seed crystal which extend beyond other regions of the seed crystal." As discussed above, Hunter does not use a seed crystal but uses either a graphite disc or a seeded disc. Balakrishna uses a seed crystal but does not disclose or suggest forming a pattern on the seed crystal as recited in Claim 11. The Official Action fails to identify any portion of Hunter or Balakrishna as disclosing the recitations of Claim 11. Accordingly, neither Hunter nor Balakrishna disclose or suggest patterning a seed crystal as recited in Claim 11. Thus, Claim 11 is separately patentable over Hunter and Balakrishna for at least these additional reasons.

In re: Stephan Mueller
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Conclusion

In light of the above discussion, Applicant submits that the present application is in condition for allowance, which action is respectfully requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (919) 854-1400.

Respectfully submitted,



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